# Form ESA-B4. Summary Report for ESA-082-3
# Public Report - Final

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| **Company** | ArcelorMittal | **ESA Dates** | 5/20/08 – 5/22/08 |
| **Plant** | Hennepin, IL | **ESA Type** | Compressed Air |
| **Product** | Steel | **ESA Specialist** | Kyle Harris |

## Brief Narrative Summary Report for the Energy Savings Assessment:

**Introduction:**

ArcelorMittal is the world's number one steel company, with 320,000 employees in more than 60 countries. It has led the consolidation of the world steel industry and today ranks as the only truly global steelmaker with an industrial presence in 27 countries. It is the leader in all major global markets, including automotive, construction, household appliances and packaging. The Group leads in R&D and technology, holds sizeable captive supplies of raw materials and operates extensive distribution networks.

The United States Department of Energy (DOE) "Save Energy Now" program completed an Energy Savings Assessment (ESA) May 20, 2008 through May 22, 2008 at the ArcelorMittal facility in Hennepin, Illinois. The DOE Qualified Specialist/Energy Expert conducting the compressed air system ESA was Kyle Harris of Accurate Air Engineering, Inc., Bakersfield, California.

The ArcelorMittal, Hennepin compressed air system includes one centrifugal air compressor and two reciprocating air compressors, operating in a central location and serving a number of different end uses including a number of open-blowing applications. The centrifugal air compressor is a 600 hp unit while both reciprocating air compressors are driven with 500 hp motors. Each air compressor has a dedicated twin-tower heatless regenerative air dryer. Each air dryer is equipped with a steam eductor that helps to reduce the compressed air purge air required for regeneration. The plant uses compressed air on a 52 week per year, 7 days a week, 24 hours per day schedule. Currently, the compressed air system uses over 8.7 million kWh/year and accounts for more that 6% of the total plant electricity consumption.

**Objective of ESA:**

Identify compressed air system improvement recommendations, train plant personnel how to correctly model the current system and predict potential savings using the DOE AIRMaster+ software tool.

**Focus of Assessment**:

Compressed air supply, distribution and end uses.

**Approach for ESA**:

Flow (scfm) data was collected from a site energy management system, verified and adjusted as needed. Together, the DOE ESA Expert and plant personnel used LogTool V2 to interpret the data and format the data for direct import into AIRMaster+. Compressor profiles were developed and a baseline compressed air profile was created within AIRMaster+.

A survey of the compressed air supply and demand was completed. As part of the "training assessment" the plant personnel, with direction from the DOE ESA Expert, created a number of energy efficient measures to evaluate the impacts of each measure. Some of these measures were already under consideration for implementation or were ready for installation. Ultimately, these measures were prioritized in order to achieve the best effect of the improvements. A closeout meeting was conducted to present the findings to a number of plant personnel that may be affected by the proposed improvements.

**General Observations of Potential Opportunities:**

The following section briefly discusses the projects identified for additional investigation or implementation. A qualifier is assigned to each project – *near-term, medium-term* or *long-term.* These descriptors are identified as follows:

- *Near-term* opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
- *Medium-term* opportunities would require purchase of additional equipment and/or changes in the system. It would be necessary to carryout further engineering and return on investment analysis.
- *Long-term* opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

**Near-Term Opportunities**

- Automate Air Compressors

  Currently, the average demand for the plant is 4,350 cfm or 61% of the total compressor capacity installed. The total compressor capacity is over 6,900 cfm. The plant uses a cascading set point control for all three air compressors which has the 600 hp centrifugal set to operate fully loaded at 115 psig. The two 500 hp reciprocating air compressors use three-step unloaders with the #3 500 hp loading first and the #1 500 hp loading next. The reciprocating air compressors do not shut down automatically if at 0% load for long periods of time.

  Though the plant demand can most often be supported with the 600 hp centrifugal and one 500 hp reciprocating air compressor, peak demands sometimes require the third air compressor to be started due to low pressure in the plant. As a result, all three air compressors are operated all of the time with at least the two reciprocating air compressors operating partially loaded. This information was verified using control room log sheets which show the #1 500 hp running at 0% capacity for extended periods of time.

  At a minimum, the plant should start to shut down the #1 air compressor during known periods of low and no production. The best choice would be to automate the system so that it would respond to system demand. The air compressors would be started when required, loaded and unloaded based on plant demand and shut down upon plant demand reductions. Ideally, the centrifugal air compressor would discharge directly into the system (after its dedicated air dryer) and the two reciprocating air compressors would discharge into the plant through an intermediate control (i.e. flow controller, demand expander).

  It is estimated by automating the air compressors that over 1.3 million kWh or near $80,000 annually could be saved with a payback ranging from 3 months to 1 year depending on the final arrangement.

- Reduce Air Leaks

  Though placed in this report as a “near-term” opportunity, leak load reduction and prevention should be considered both a short and long term goal. Savings estimates assume that the air compressors are properly controlled and respond to the load reductions.

  It is conservatively estimated that the plant has at least 200 cfm of demand that serve plant leaks (i.e. pipe joints, hoses, tubing). If the plant were to reduce this leak load by 50% or 100 cfm and maintain the leak load at this level, it is estimated that over 200,000 kWh or $13,000 annually could be saved.

**Medium-Term Opportunities**

- Optimize Air Treatment

  Each air compressor has a dedicated twin-tower heatless regenerative air dryer. Each Pall model 2001HV1 air dryer is equipped with a steam eductor that uses an average of 1,280 PPH of steam at 200 psig. The eductors pull a vacuum on the dryer off-stream tower to help to reduce the compressed air purge air required for regeneration. The average purge is below 3% of the rated dryer capacity (2,500 cfm) or 68 cfm.

  The pressure drop across the clean-up equipment (i.e. piping, filtration, air dryer) was tested as high as 20 psig. While the plant pressure operates at an average of 92 psig, the compressor discharge pressures were over 112 psig. Though a small amount of the pressure drop is normal for filtration and air dryers, most of the existing pressure drop is due to undersized piping after the compressor air receiver to where it enters the main distribution header. Each air compressor discharges through a 12" pipe into a 1,665-gallon air receiver and then through a 3" pipe from the air receiver, through the clean up equipment before entering the main 12" plant header. While the "Compressed Air Challenge" and DOE recommend the air velocities in primary headers do not exceed 20 feet-per-second (fps), the velocities through the 3" pipe can be as high as 114 fps.

  This facility has already investigated the replacement of the air dryers based upon the reduction in steam consumption and ultimately natural gas. In addition to the elimination of the steam requirement, some purge air savings will be realized though most likely offset by the need for electric heaters and blowers. The other most attractive opportunity while replacing the air dryers is to increase the pipe size from the air receivers to the main header. This pipe size should be at least 6" pipe while 8" would be preferred reducing the velocity to below 20 fps.

  It is estimated by replacing the existing air dryers, filtration and piping that over 14,979 mmBTU of natural gas and over 450,000 kWh or near $180,000 annually could be saved with a payback ranging from 1.6 years to 2.2 years depending on the final arrangement.

**Long-Term Opportunities**

- Replace Open-Blowing Applications

  The U.S. Department of Energy (DOE) and the Compressed Air Challenge® (CAC) recognize open blowing applications as potential inappropriate uses of "compressor room" compressed air. The choice to use compressed air in these applications is generally because it's readily available and simple to use but as a result overlooks more cost-effective solutions. The CAC promotes plants to use compressed air only if safety enhancement, significant productivity gains, or labor reductions will result.

  Assuming the typical ¼" blow off fixture had an air delivery pressure of 200"WC in the center of the air stream, an air exit velocity of over 54,000 FPM and a consumption of 14 -18 CFM of compressor room performance, the mass flow of air is 1.32#/min and the delivered force calculates to 41,347 Newtons of energy. This same application could be replaced with a .52" nozzle bore with a 3 PSI supply pressure (blower) and supply 52 CFM at an air exit velocity of 35,900 FPM at 78"WC. The mass flow of air would be 3.85 pounds of air per minute and a delivered force of 52,611 Newtons. The 3 PSI blower supply would represent 28% more delivered energy to the process than the plant air blow off fixture.

  There are a number of open-blowing applications in the facility that could be eliminated or replaced with blowers including the Pot Area blow off, the #4, #5 and #6 Bridle blow off and the Temper Mill blow off. These production applications are prefect examples of DOE and CAC target projects that most often can be replaced with lower pressure compressed air, increasing the delivered force to application and reducing the amount of compressed air required from the plant air compressors. The Hennepin plant has already ordered a LP blower and air knives to replace the Pot Area blow off and another plant is testing LP blower replacements for the Temper Mill application.

  It is estimated that at least 1,300 cfm of plant demand is used for these open blowing applications. Once replaced with LP blowers, over 900,000 kWh or $54,000 annually could be saved. The estimated payback is 2.3 to 3.0 years depending on the final arrangement.

**Management Support and Comments**:

ArcelorMittal, Inc. is dedicated to reducing energy consumption throughout its plants worldwide. Paul Downey and Don Richards provided support prior to the ESA commencing as well as during and after the ESA. They are dedicated to improve the compressed air system at the Hennepin plant.

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